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INTRODUCTION

Except for the seed yields report in (*1*) and seeds per pound in (*2*), there is no information readily available on seed size, weight, number of seeds per pound or yield per acre of various *Desmodium* species. A number of desmodiums are being evaluated for forage use in various parts of the world and in Hawaii. Among those are *D. intortum* (Mill.) Urb., greenleaf desmodium; *D. uncinatum* (Jacq.) DC., silverleaf desmodium; *D. canum* (Gmel.) Schintz and Thellung, kaimi clover; and *D. sandwicense* E. Mey., spanish clover. The use of these desmodiums, or any other forage plant, for that matter, requires knowledge of seeding rates, which are dependent, in part, on seed size.

METHODS AND MATERIALS

The accession numbers listed in tables 1 and 2 are the introduction record numbers assigned to each lot of seed as it was collected locally or introduced from various foreign sources by the Department of Agronomy and Soil Science, University of Hawaii. At least one herbarium voucher specimen was prepared from the various accessions of each species with but few exceptions, and are on deposit in the Arnold Herbarium of Harvard University, Springfield, Massachusetts, where positive identification was made. Other specimens are on deposit in the Agronomy and Soil Science herbarium collection.

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The accessions were planted at the Waimanalo Experimental Farm, Oahu, Hawaii Agricultural Experiment Station, and were grown under uniform fertility and moisture conditions. Seeds were harvested from the entire collection during the fall and winter of 1963-64 from all accessions except for those of *D. canum*. The detailed seed studies of *D. canum* were made from the seed harvested in June 1965. The seeds were threshed and cleaned with a fanning mill to remove small particles of debris. The seeds were counted and weighed to the nearest one hundredth of a gram. During the counting process, all shrivelled seeds and bits of trash were removed. No attempt was made to grade the seed of any accession into different-sized lots. In making the detailed study of *D. canum* seed weights, ten 1000-seed lots were taken at random from each accession.

RESULTS AND DISCUSSION

The 1000-seed weights and number of seeds per pound for each accession are presented in table 1. The 1000-seed weights varied from 0.80 gram for *D. pulchellum* to 8.09 grams for *D. canadense*. There was considerable variation within any one species; for example, in *D. canum* the 1000-seed weights varied from 2.68 to 5.57 grams per 1000 seeds. *D. intortum*, one of the more promising forage species, also shows considerable variation. In *D. intortum*, the accessions can be separated into two types based on seed size, those with weights from 1.22 to 1.41 grams per 1000 seeds and those with seed weights varying from 1.58 to 1.99 grams per 1000 seeds. HES 5142 has been tentatively identified as *D. intortum*, but positive identification is lacking. Seeds of this accession are much heavier than any other accession of *D. intortum*. From the floral characteristics and seed size, it is possible that HES 5142 is not *D. intortum*, but may be either a hybrid or a closely related species.

In table 2 are presented the results from a detailed study of seed weights of *D. canum*. Each value in column 2 is the average of ten 1000-seed weights of seeds taken at random from each of 25 accessions. Each seed lot was remarkably uniform in size as judged by the very small standard error. The accessions may be divided into three very distinct groups as determined by the fiduciary limits provided by Duncan's Multiple Range Test, as presented in Federer (*3*).

The accessions of *D. canum* listed in tables 1 and 2 represent local types collected in Hawaii as well as foreign introductions. Accession numbers 63-1001, 63-1002, and 63-1003 are from putative hybrids between HES 5146 and HES 5145. P2630 is from an off-type plant found in HES 5155.

Some of the variation found here may be due to environmental causes or to small immature seed, but most of the variation is real and is due to inherent genetic differences within the species. Among the accessions of *D. canum*, individual plants within an accession are remarkably uniform in overall appearance, pod size, flower color, and growth habit. This further suggests that *D. canum* is self-pollinated to a high degree. HES 5194 represents seed from three original plants. This accession appears to be segregating for a number of morphological traits, and some plants are quite unlike the original; yet, examination of seeds from individual plants within the accession shows no obvious difference in seed size. There are a number of striking differences in the growth habit of the *D. canum* accessions and it is quite easy to see how some of the accessions received different names.

Figures 1–10 are indicative of the variation in seed size of several different *Desmodium* species. Figures 1–5 are of various accessions of *D. canum*, kaimi clover; figures 1 and 3 are of seeds from local collections and figures 2, 4, and 5 are of introduced accessions. Figure 6 is of seeds from *D. sandwicense*, spanish clover. Figures 7, 8, and 9 are of different accessions of *D. intortum*, commonly known as giant spanish clover or greenleaf desmodium; the seeds of figures 7 and 9 are definitely smaller than those in figure 8. Figure 10 is of seeds of *D. uncinatum*, silverleaf desmodium; note that they are much larger than those of *D. intortum* or *D. sandwicense* and that they are different in shape from those of *D. canum*.

The differences in seed size presented here indicate that there may be considerable room for increasing the seed size of some of the more useful species. Large seed size implying ample nutrient reserves for young seedlings is very important from the viewpoint of successful establishment of legumes as useful components of a mixed vegetation, pasture, and especially in overseeding established swards where competition reduces the margin for survival.

TABLE 1. Thousand-seed weights and number of seeds per pound of *Desmodium* species

Species	Accession No.	Thousand-seed weight (grams)	No. of seeds per pound
Desmodium barbartum (L.) Benth. & Oerst.	5026	1.09	416,500
	5027	1.07	424,300
	5028	1.36	333,800
D. batocaulon A. Gray	5147	2.98	152,300
	5147	2.59	175,200
D. cajanifolium (H.B.K.) DC.	5328	1.63	278,500
	5358	1.15	394,700
D. campylocaulon F. Muell, ex Benth.	5546	3.04	149,300
D. canadense (L.) DC.	5153	8.09	56,100
	5199	6.65	68,200
	5200	4.29	105,800
	5202	6.23	72,800
	5206	5.65	80,300
	5352	4.33	104,800
	5359	4.29	105,800
	5410	6.40	70,900
	5537	7.20	63,000
	5538	6.75	67,200
D. canum (Gmel.) Schintz & Thellung	4509	5.02	90,000
	5000	5.29	85,000
	5008	4.13	109,900
	5009	5.00	90,800
	5010	4.25	106,800
	5051	5.46	83,100
	5138	5.32	85,300
	5145	4.44	102,200
	5146	4.26	93,800
	5148	4.17	108,800
	5155	5.08	89,300
	5194	4.49	101,100
	5321	3.02	150,300
	5322	2.68	169,400
	5324	4.74	95,700
	5326	2.00	227,000
	5334	5.21	87,100
	5335	5.17	87,800
	5336	4.46	101,800
	5362	5.57	81,500
	5363	5.33	85,100
	5586	4.46	101,800
	P2630	2.87	158,100
	63-1001	4.30	105,600
	63-1002	4.19	108,300
	63-1003	3.74	121,400

(Continued)

TABLE 1. Thousand-seed weights and number of seeds per pound of *Desmodium* species (Continued)

Species	Accession No.	Thousand-seed weight (grams)	No. of seeds per pound
D. cuneatum Hook. & Arn.	4240	2.91	156,000
	4805	2.12	214,000
	5030	3.45	131,600
D. dichotomum (Willd.) DC.	4155	2.89	157,000
D. discolor Vogel	4170	1.58	287,300
	4788	1.41	322,000
	5162	2.12	214,100
	5514	1.75	259,900
D. distortum (Aubl.) Macbr.	4190	1.55	292,900
	4525	1.27	357,500
	5031	1.57	289,100
	5144	1.44	315,300
	5346	1.25	363,000
	5344	1.23	369,000
	5390	1.73	262,400
	5408	1.90	238,900
D. gangeticum (L.) DC.	5347	1.12	405,300
	5407	1.19	381,500
	5536	1.60	283,700
D. glabrum (Mill.) DC.	4386	1.20	378,000
	4786	1.20	378,000
D. gyroides DC.	5140	4.40	103,200
D. heterocarpon (L.) DC.	4530	1.61	281,900
	4998	1.58	287,300
	4999	1.53	296,700
	5143	3.79	119,800
	5165	1.58	287,300
	5354	1.53	296,700
D. intortum (Mill.) Urb.	4247	1.58	287,300
	4247	1.67	271,856
	4331	1.30	349,200
	5035	1.62	280,200
	5053	1.73	262,400
	5133	1.58	287,300
	5136	1.99	228,100
	5142	3.61	125,700
	5149	1.69	268,600
	5193	1.80	152,200
	5391	1.30	349,200
	5392	1.41	321,900
	5405	1.70	267,000
	5513	1.36	333,800
	5517	1.22	372,100

(Continued)

TABLE 1. Thousand-seed weights and number of seeds per pound of *Desmodium* species (Continued)

Species	Accession No.	Thousand-seed weight (grams)	No. of seeds per pound
D. molliculum (H.B.K.) DC.	5331	2.00	227,000
D. motorium (Houtt.) Merrill	5533	4.41	102,900
D. nicaraguense Oerst. ex Benth. et Oerst.	5037	1.26	360,300
	5125	1.25	363,200
	5134	1.21	375,200
D. ovalifolium Wall.	5039	2.18	208,200
	5132	1.79	252,600
	5196	2.10	216,200
	5325	1.92	236,400
	5409	1.93	235,200
D. painteri (Rose & Standl.) Standl.	5357	6.24	72,700
	5357	7.15	63,500
D. perplexum Schubert	5168	4.05	112,000
	5169	4.38	103,600
	5170	4.79	94,800
D. pulchellum Benth.	5532	0.80	567,500
D. ramosissimum G. Don	5339	2.18	208,200
D. salicifolium (Poir. ex Lamk.) DC.	5526	3.11	145,900
D. sandwicense E. Mey.	5012	3.33	136,300
	5013	4.42	102,700
D. scorpiurus (Sw.) DC.	5141	2.43	186,800
D. sericophyllum Schlecht.	5329	2.11	215,200
D. tiliafolium (D. Don) G. Don	5523	3.20	141,800
	5524	6.09	74,500
D. tortuosum DC.	4383	2.71	167,500
	4383	3.79	119,700
	5032	2.19	207,300
	5041	2.32	195,600
	5042	2.42	187,600
	5043	2.48	185,300
	5044	2.38	190,700
	5047	2.08	218,200
	5050	2.60	174,600
	5156	2.24	202,600
	5171	2.39	189,900
	5178	2.05	221,400
	5179	2.41	188,300
	5180	2.61	173,900
	5333	2.51	180,800
	5396	3.11	145,900

(Continued)

TABLE 1. Thousand-seed weights and number of seeds per pound of *Desmodium* species (Continued)

Species	Accession No.	Thousand-seed weight (grams)	No. of seeds per pound
	5400	2.05	221,400
	5401	2.29	198,200
	5402	2.36	192,300
	5403	2.16	210,100
	5404	2.49	182,300
	5512	2.42	187,600
	5515	2.46	184,500
	5519	2.59	175,200
	5534	2.46	184,500
D. triquetrum DC.	5343	3.91	116,112
D. uncinatum (Jacq.) DC.	5021	4.18	108,600
	5025	4.26	106,600
	5054	4.11	110,400
	5584	4.00	113,500
D. varians (Labill.) G. Don	5525	2.22	204,500
D. velutinum (Willd.) DC.	3557	1.90	238,900
	5350	1.88	241,400
	5353	3.09	146,925

TABLE 2. The variation in seed weights of 25 accessions of *D. canum*, kaimiclover

Accession No.	Average 1000-seed weight (grams)[1]	Duncan's multiple range test[2] 5%	1%
5362	5.57 ± .02	⌐	⌐
5051	5.46 ± .02	⌐	⌐
5363	5.33 ± .01	⌐	⌐
5138	5.32 ± .04	⌐	⌐
5000	5.29 ± .07	⌐	⌐
5334	5.21 ± .03	⌐	⌐
5335	5.17 ± .03	⌐	⌐
5155	5.08 ± .02	⌐	⌐
4509	5.02 ± .02	⌐	⌐
5009	5.00 ± .01	⌐	⌐
5324	4.74 ± .05	⌐	⌐
5194	4.49 ± .10	⌐	⌐
5336	4.46 ± .02	⌐	⌐
5586	4.46 ± .01	⌐	⌐
5145	4.44 ± .01	⌐	⌐
63-1001	4.30 ± .06	⌐	⌐
5146	4.26 ± .03	⌐	⌐
5010	4.25 ± .03	⌐	⌐
63-1002	4.19 ± .03	⌐	⌐
5148	4.17 ± .04	⌐	⌐
5008	4.13 ± .02	⌐	⌐
63-1003	3.74 ± .02	⌐	⌐
5321	3.02 ± .02	⌐	⌐
P2630	2.87 ± .01	⌐	⌐
5322	2.68 ± .03	⌐	⌐

[1] This average is composed of ten one-thousand seed weights taken at random from each accession.

[2] All those values which are covered by a common bracket are considered to be not significantly different from each other and items not within the same bracket differ significantly.

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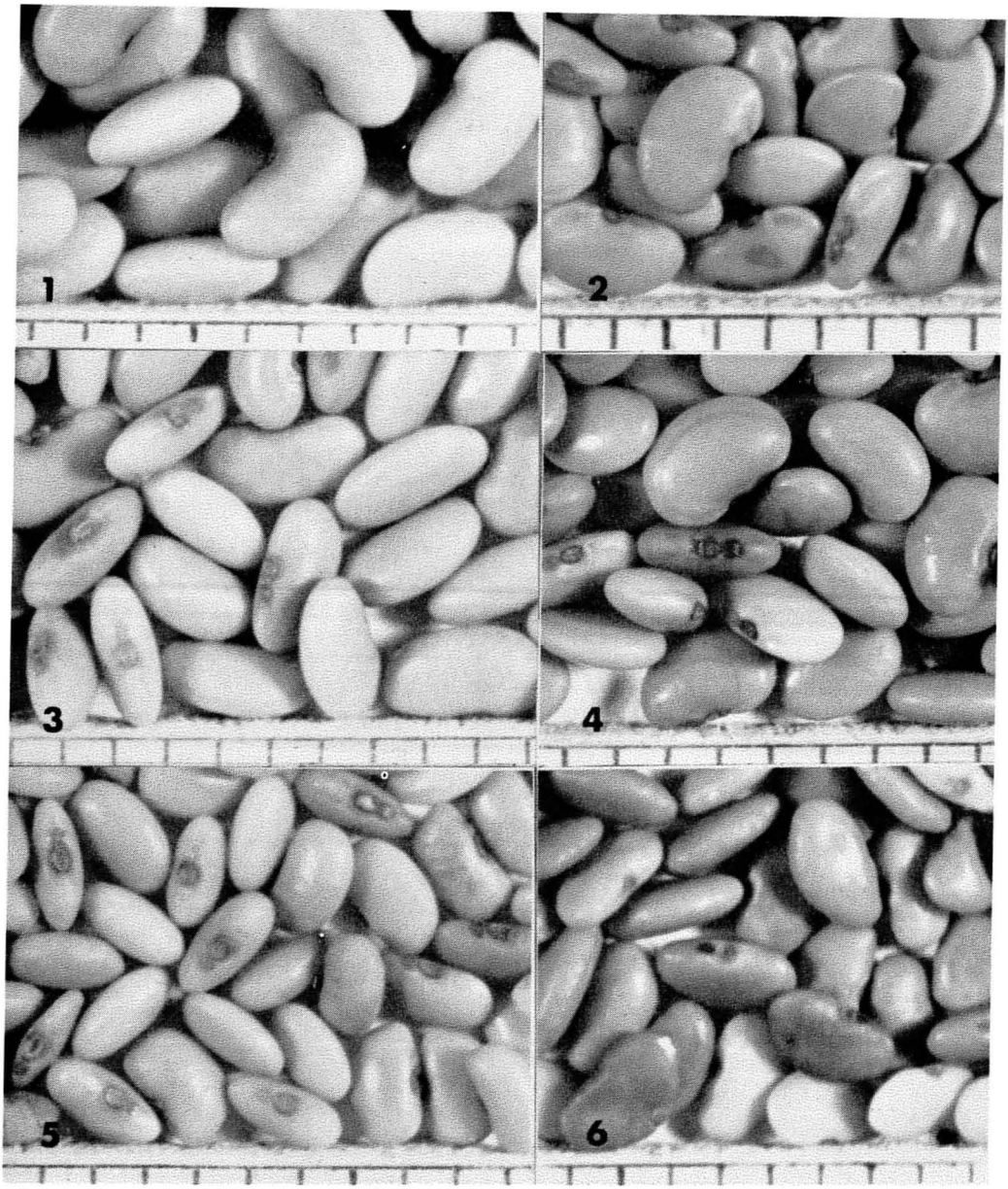
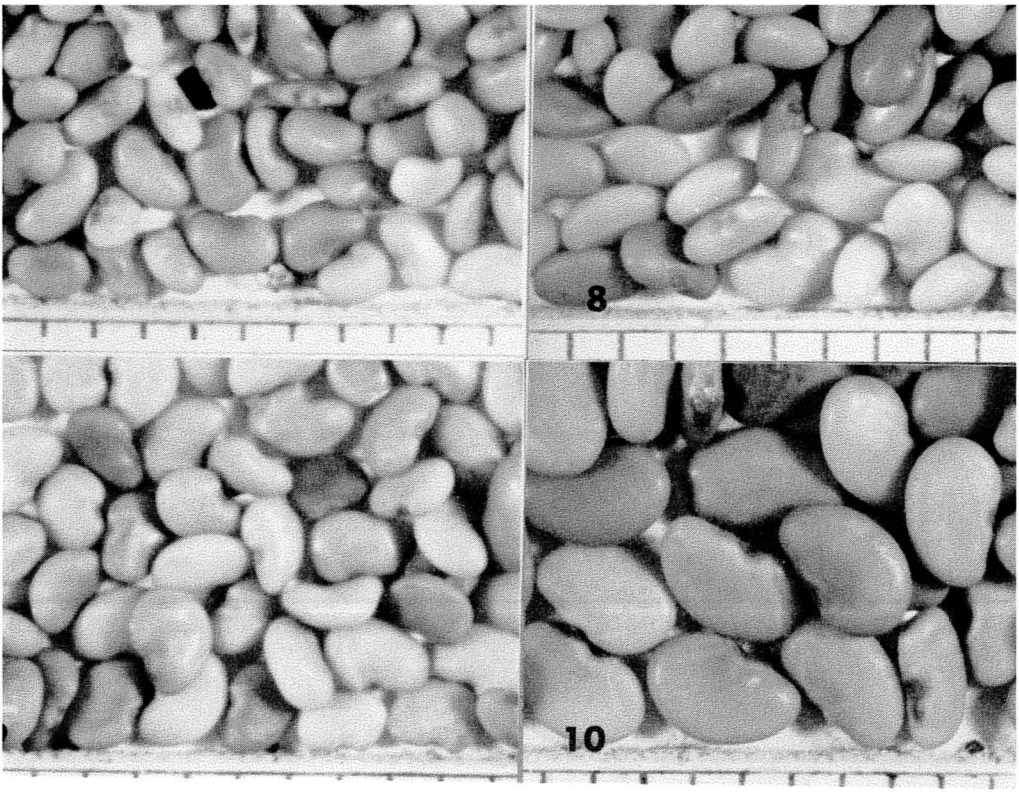


Figures 1–10. Photographs of seeds from different *Desmodium* species. The distance between each division of the scale on each photograph represents 1 millimeter. Fig. 1–*D. canum*, HES 5362; Fig. 2–*D. canum*, HES 5586; Fig. 3–*D. canum*, HES 5000; Fig. 4–*D. canum*, HES 5148; Fig. 5–*D. canum* P2630; Fig. 6–*D. sandwicense*, HES 5013.



Figures 7–10. Photographs of seeds from different *Desmodium* species. The distance between each division of the scale on each photograph represents 1 millimeter. Fig. 7–*D. intortum*, HES 5517; Fig. 8–*D. intortum*, HES 5136; Fig. 9–*D. intortum*, HES 4331; and Fig. 10–*D. uncinatum*, HES 5025.

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